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GEOMETRY.

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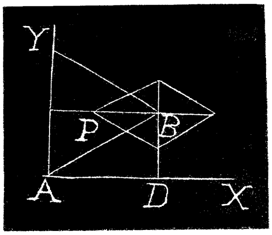
167. Proposed by **JOHN M. QUINN**, Professor of Mathematics. High School, Warren, Pa.

If at the vertex of an isosceles triangle one of whose basal vertices is pivoted and the other free to move in a straight line, a rhombus be pivoted with sides parallel to the sides of the triangle, the locus of every point on the rhombus except the one which is its intersection with the fixed side of the triangle is an ellipse.

Solution by the PROPOSER.

Notation. Let X and Y be rectangular axes; θ the angle BAX; m equal segments of the sides of the triangle and the rhombus; $AB=a$, $BD=y$, and $AD=x$, and YBA an isosceles triangle with one basal vertex pivoted at A. The other basal vertex is free to move along the line AY.



To prove that the locus of any point as P is an ellipse.

PROOF. $y/a=\sin\theta$. $\therefore$ $y^2/a^2=\sin^2\theta$.

$x=a\cos\theta-2m\cos\theta=\cos\theta(a-2m)$.

$$\frac{x}{a-2m}=\cos\theta,\quad \frac{x^2}{(a-2m)^2}=\cos^2\theta.$$

$$\therefore \frac{y^2}{a^2}+\frac{x^2}{(a-2m)^2}=\sin^2\theta+\cos^2\theta=1.$$ $\therefore$ the locus of p is an ellipse.

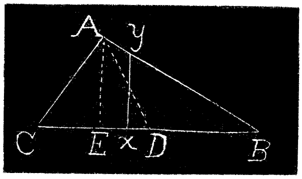
Similarly for any other point *mutatis mutandis*. Q. E. D.

168. Proposed by **MISS GUBELMAN**, Student Southern Illinois State University, Carbondale, Ill.

To draw a perpendicular to one side of a triangle dividing it into two equivalent parts.

Solution by the PROPOSER.

1. Let ABC be the triangle. Draw the median AD and the perpendicular AE. Construct BX such that $BX^2=BD.BE$. Draw the perpendicular XY.



$\therefore$ $\triangle BXY : \triangle BAE = BX^2 : BE^2$.

Similar triangles$=BD\times BE=BE^2=BD:BE$.

Also $\triangle BAD : \triangle BAE = BD:BE$, having equal altitudes.

$\therefore$ $\triangle BXY : \triangle BAE = \triangle BAD : \triangle BAE$.

$\therefore$ $\triangle BXY = \triangle BAD$. But $\triangle BAD=\frac{1}{2}\triangle ABC$. Median.

$\therefore$ $\triangle BXY=\frac{1}{2}\triangle ABC$. $\therefore$ XY is the required perpendicular.

Also solved by *G. B. M. ZERR*, *DANIEL B. NORTHRUP*, *L. C. WALKER*, *J. SCHEFFER*, *H. C. WHITAKER*, *H. B. PENHOLLOW*, and *P. W. WEBBER*.

169. Proposed by **S. F. NORRIS**, Professor of Astronomy and Mathematics, Baltimore City College, Baltimore, Md.

Theorem. Two quadrilaterals having three sides of the one equal to the thre corresponding sides of the other, each to each, and the two corresponding angles adjacent to the unknown sides equal, each to each, are equal figures. [From *Olney's Geometry*, Section VIII, Proposition XIV].

1. Required proof. 2, Is this proposition found in any other text-book of Geometry?